Aug 81

Continuing Engineering Education Program

George Washington University
Announces Four Short Courses
To Be Held in the Nation's Capital

STATISTICAL METHODS IN DISCRETE EVENT SIMULATION

November 4-6, 1981
Course No. 496DC

BAYESIAN STATISTICS FOR ENGINEERS AND SCIENTISTS

November 9-13, 1981
Course No. 744DC

STATISTICAL METHODS IN RELIABILITY

December 14-18, 1981
Course No. 5DC

ANALYSIS OF VARIANCE FOR DATA HAVING UNEQUAL NUMBERS OF OBSERVATIONS IN THE SUBCLASSES

December 14-16, 1981
Course No. 558DC

TECHNICAL EDUCATION IS AN INVESTMENT IN THE FUTURE

WASHINGTON, D.C. 20052
(202) 676-6106
(800) 424-9773
TELEX 64374 (International)

STATISTICAL METHODS IN DISCRETE EVENT SIMULATION

November 4-6, 1981

WHO SHOULD ATTEND

This course is designed for systems analysts, statisticians, engineers, and others who use simulation techniques in their work or who manage projects that use simulation.

COURSE OBJECTIVES

Upon completion of this course, participants should be able to:

- apply an output analysis technique that best fits the simulation problem at hand
- determine whether the output is sufficiently accurate for intended needs
- correct inaccuracies
- plan simulation runs beforehand
- select the best among several simulated systems
- use techniques that give a specified accuracy at reduced cost
- sample efficiently from diverse distributions

DESCRIPTION

The course describes statistical methods that produce timely and enlightening output analyses in a discrete event simulaton. Each method is illustrated with an example. For one exceptionally useful technique called the regenerative method, parallel examples of the same problem are presented in SIMSCRIPT II, GPSS, SIMPL/1, and SIMULA.

The methods of output analysis include the regenerative, batch means, autoregressive, and spectrum techniques. The regenerative approach exploits the structure of the simulation model in a way that allows the use of elementary statistical techniques for output analysis. The batch means, autoregressive, and spectrum methods apply when this structural exploitation is not possible.

The course also describes stopping rules for obtaining results with a specified accuracy; variance reduction techniques to gain statistical efficiency; rules for reducing the effect of initial conditions; experimental design to analyze the changes in output behavior due to changes in several inputs simultaneously; ranking and selection procedures aimed at finding the best among several systems; contemporary concepts in random number generation; and sampling from distributions on a computer.

PREREQUISITE

Knowledge of probability theory and intermediate statistical inference. Experience with discrete event simulation would be helpful, but is not essential.

OUTLINE

- Structural Output Analysis I
  Bookkeeping, data collection and analysis, point and interval estimates, interpreting sample results, sequential estimation, verifying assumptions, variance reduction
- Structural Output Analysis II
  Exponential occupancy times, selecting a demarcating state, non-exponential times, testing for approximate regeneration, variance reduction
- Non-structural Output Analysis
  Batch means, autoregressive and spectrum methods, verifying assumptions
- Analysis of Experiments
  Factorial experiments, simultaneous interval estimates, comparison of experiments, choosing among alternative systems
- Other Types of Simulations
  Discrete-continuous, fixed time advance and non-stationary models
- Sampling
  Random number generation methods, theoretical and empirical evaluation, efficient sampling from diverse distributions on a computer

INSTRUCTOR

George S. Fishman is a well-known authority on discrete event simulation and is Professor of Operations Research and Systems Analysis at the University of North Carolina at Chapel Hill. He has worked in the area of discrete event simulation for over 15 years and is best known for his development of many statistical methods for analyzing simulation output. Dr. Fishman has lectured extensively on all aspects of simulation and has consulted with government and private industry on the modeling, programming, and statistical analysis of many diverse simulations. His book, *Principles of Discrete Event Simulation,* published by Wiley in 1978, presents an up-to-date account of the myriad techniques that have been found useful in simulation work. It is considerably different in concept and scope from his earlier book, *Concepts and Methods in Discrete Event Simulation,* published by Wiley in 1973, which has long been one of the best-selling textbooks in discrete event simulation. Professor Fishman is the simulation department editor for *Management Science.*

TEXT

Participants will receive a copy of *Principles of Discrete Event Simulation* and a set of notes which contains copies of the lecturer's viewgraphs.

FEE

The fee for this course is $575. This includes text, lecture notes, and supplies. Make checks and purchase orders payable to GWU, Continuing Engineering Education. Participants may delay payment until arrival.

Course No. 744DC

BAYESIAN STATISTICS FOR ENGINEERS AND SCIENTISTS

November 9-13, 1981

COURSE OBJECTIVE

To provide participants with a coverage of Bayesian ideas and techniques for solving a wide variety of industrial, scientific, and engineering problems.

WHO SHOULD ATTEND

Engineers, scientists (physical and biological), operations research analysts, and decision makers who wish to use statistical methods for solving problems, and who want to be introduced formally to, or learn more about, the Bayesian approach to problem solving.

DESCRIPTION

The Bayesian approach for solving practical statistical and other decision-making problems is becoming more and more popular with engineers and scientists in government and industry. It is well known that Bayesian inference is unified, logically coherent, and thus easy to understand. It is relevant and realistic because it demands of the user a good understanding and intimate knowledge of an actual physical problem.

In this course, an outline of the relevant theory and principles underlying Bayesian thought is presented and illustrated by practical examples from various situations. Practical applications are emphasized.

PREREQUISITE

A degree in science or engineering and an introductory course in probability and/or statistics would be helpful.

OUTLINE

- Introduction to the calculus of probability and probability manipulations.
- The Bayesian method: description of uncertainty through probability; scoring rules.
- Connections with sample theory procedures; the unsatisfactory nature of sample theory notions such as confidence limits, significance levels, tests of hypotheses, etc.
- Illustration of a worked example from reliability and life testing using the exponential and the Weibull distributions.
- The likelihood principle; illustration via the binomial and other members of the exponential family.
- Decision making and the principle of maximizing expected utilities, with practical applications to insurance and engineering economics.
- Notion of exchangeability and its applications.
- Subjective assessment of probabilities and utilities; scoring rules for probabilities; prior information and its combination.
- The Kalman Filter and its applications to analysis of variance, ridge regression, time series analysis, and forecasting.
- Shrinkage estimators.
- Computer programs and packages for Bayesian statistics.
- Throughout the course, applications from engineering, science, and other fields will be presented and discussed depending upon the interest of the participants and the availability of time. Examples of these are: dose response experiments, sensitivity testing, accelerated life testing, quality control, systems and software reliability analyses, and hydrological applications.

INSTRUCTORS

Richard E. Barlow, Professor of Operations Research and Statistics, University of California, Berkeley. Dr. Barlow is a Fellow of the Institute of Mathematical Statistics and of the American Statistical Association, and an elected member of the International Statistical Institute. He is co-author of *Mathematical Theory of Reliability* and *Statistical Inference Under Order Restrictions,* and co-editor of *Reliability and Fault Tree Analysis.*

Dennis V. Lindley is recognized internationally as one of the foremost proponents of Bayesian thought. He was educated at Cambridge University, England, and was a member of the faculty there during the period 1948-1960. He was head of the Departments of Statistics, Aberystwyth, 1960-1967, and University College, London, 1967-1977. He has held visiting appointments at Harvard and Stanford Universities; the Universities of Chicago, Rome, Iowa, California (Berkeley), and Wisconsin; and Christchurch College. His publications include *Introduction to Probability and Statistics from a Bayesian Viewpoint, Bayesian Statistics: A Review,* and *Making Decisions.*

Nozer D. Singpurwalla, Professor of Operations Research and Research Professor of Statistics at George Washington University. Dr. Singpurwalla is a Fellow of the American Statistical Association and an elected member of the International Statistical Institute. He is a co-author of *Methods for Statistical Analysis of Reliability and Life Data* and co-editor of *Reliability and Fault Tree Analysis.*

TEXT

Making Decisions by D.V. Lindley, John Wiley & Sons Ltd., 1971.

FEE

The fee for this course is $745. This includes text, lecture notes, and supplies. Make checks and purchase orders payable to GWU Continuing Engineering Education. Participants may delay payment until arrival.

STATISTICAL METHODS IN RELIABILITY

December 14-18, 1981

WHO SHOULD ATTEND

Those engineers, statisticians, and other scientists interested in applying the latest developments in reliability theory and techniques to the solution of reliability and system safety problems.

DESCRIPTION

This course presents the basic techniques of statistical reliability and then covers the applications of some recent developments in reliability theory, such as total time on test processes, time series analysis of failure data, failure data analysis, accelerated life testing, failure rate estimation, network reliability, redundancy, optimization, and graphical and computer techniques for failure data analysis.

A session has been scheduled for class discussion of selected, real-life problems proposed by the participants. The discussion will define these problems and direct participants along the most promising avenues of resolution. Participants who have problems to be considered for discussion at this session should submit a typewritten copy on the first day of the course.

PREREQUISITE

Completion of a basic course in probability and statistics or a sound working knowledge of these subjects.

OUTLINE

Statistical Failure Models
Introduction to statistical methods in reliability, availability, and maintainability; definitions, techniques, and applications. Deviation of the exponential, gamma, Weibull, extreme value, and lognormal distribution based on component failure considerations. Models for competing risks and failures due to fatigue. Multivariate distributions for dependent components.

Statistical Analysis of Failure Data
Life tests based on exponential, Weibull, gamma, and extreme value distribution. Confidence limits on the mean time to failure and the reliability function. Graphic methods of fitting failure distributions, and goodness-of-fit test procedures.

Monotone Failure Rate in Reliability
Notion of increasing and decreasing failure rate and its implications in reliability problems. Properties of distributions with monotime failure rates, emphasizing some results about the mixture of distributions having non-increasing failure rates. Case history illustrating the application of these concepts.

Theory of Coherent Structures and Network Reliability
Definitions of coherent structures, event trees, and fault trees. Min paths and min cuts, bounds on the reliability function. Notion of association and its application for the analysis of dependent failures. Applications.

Redundancy Optimization
Redundancy optimization with applications in spares provisioning and system design. Algorithms for the solution of problems with extensions and generalizations of the basic model. Examples.

Recent Graphical and Computer Techniques for Failure Data Analysis
Total time on test processes and total time on test plots with applications to selected equipment failure data. Properties and advantages of total time on test plots, and computer program packages for reliability evaluation.

Maintenance Policies and Their Optimization
Survey of renewal theory with emphasis on results applicable in maintenance. Operating characteristics and comparison of age and block replacement policies. Applications in which one policy is preferable to the other. Stochastic properties of a device undergoing alternating failure and repair. Optimization of age, block and replacement with minimal repair policies. Availability of components and of coherent systems. Maintenance through both spares and repairs.

Bayes Methods in Reliability
Bayes philosophy, comparison of Bayes methods to classical methods, prior and posterior distribution. Bayes estimates of reliability and the MTBF.

Recent Developments in the Applications of Reliability
Time series analysis methods for forecasting failure rates and tracking reliability growth. Topics in accelerated life testing and failure rate estimation.

Participant Problem Consulting and Discussion Session
Discussion of selected real-life problems presented by the participants. Staff and participants will attempt to define the problems and explore the most promising avenues of solution.

INSTRUCTORS

Richard E. Barlow, see biography with Course No. 744.

Frank Proschan, Professor of Statistics, Florida State University. Dr. Proschan is a Fellow of the Institute of Mathematical Statistics and of the American Statistical Association, and an elected member of the International Statistical Institute. He has published over 100 papers in various mathematics and statistics journals. He is co-author of *Mathematical Theory of Reliability* and of *Statistical Theory of Reliability and Life Testing* and co-editor of *Reliability and Biometry.*

Nozer D. Singpurwala, see biography with Course No. 744.

TEXTS

Statistical Theory of Reliability and Life Testing by Barlow and Proschan.

Methods for Statistical Analysis of Reliability and Life Data by Mann, Schafer, and Singpurwalla.

FEE

The fee for this course is $745. This includes texts, lecture notes, and supplies. Make checks and purchase orders payable to GWU, Continuing Engineering Education. Participants may delay payment until arrival.

ANALYSIS OF VARIANCE FOR DATA HAVING UNEQUAL NUMBERS OF OBSERVATIONS IN THE SUBCLASSES

December 14-16, 1981

WHO SHOULD ATTEND

This course is designed for engineers, statisticians, and scientists engaged in using analysis of variance techniques on data that have unequal numbers of observations in the subclasses. This includes not only data from designed experiments in which some experimental units have failed, but also data wherein there are unequal numbers of observations in the subclasses. The objective of the course is to describe and illustrate analysis of variance techniques suitable for such data.

DESCRIPTION

The course starts with a quick survey of the analysis of variance of equal-subclass-numbers data in the completely randomized design, the two-way hierarchical design, and the randomized complete block design. It then proceeds to comparable analyses when there are unequal numbers of observations in the subclasses, including some empty subclasses. Considerable time is spent on the two-way layout, rows and columns (analogous to randomized complete blocks), detailed discussions of estimable functions, tests of hypotheses, sum of squares, interactions, and the different models that can be used. This includes description of the variety of sums of squares given as output by different statistical computing packages. Annotated output from several packages, such as SAS, GENSTAT, BMDP, and SPSS will be presented and discussed in detail.

At the conclusion of the course, participants should be able to approach their own work in the analysis of variance of unequal-subclass-numbers data with a greater understanding of the various methods and calculations available, and of the different information available as output from several computer packages.

PREREQUISITE

A basic understanding of analysis of variance and least squares equations in straightforward experimental designs. A knowledge of matrix algebra, to the point of understanding equations $X'Xb = X'y$ and solution $b = (X'X)^{-}X'y$, would be helpful but is not essential.

OUTLINE

- Balanced data (equal subclass numbers) and unbalanced data (unequal subclass number); designed experiments and survey-style data.
- Review of analysis of balanced data (designed experiments): the 1-way classification (completely randomized design), the 2-way classification (randomized complete blocks), and the 2-way nested (hierarchical) classification.
- Summary of basic least squares results pertinent to analysis of variance.
- The R-notation for reductions in sums of squares.
- The 1-way classification with unbalanced data.
- The 2-way nested classification with unbalanced data.
- The 2-way crossed classification (with and without interaction) with unbalanced data.
- Hypothesis tests, estimable functions, restricted models, sums of squares, and applied topics will be described in detail for each of the 1-way and 2-way classifications.
- Extensions to 3-way and higher-order classifications.
- Computer output from SAS, GENSTAT, BMDP, and SPSS programs will be explained and illustrated. Participants will receive copies of output from these programs annotated by the instructor, describing the output in terms of the material presented in this course.

INSTRUCTOR

Shayle R. Searle is Professor of Biological Statistics at Cornell University. He is a Fellow of the American Statistical Association and an elected member of the International Statistical Institute.

His specialty in statistics is the analysis of variance for data having unequal numbers of observations in the subclasses, this being the main theme of his text *Linear Models.* His over 70 research papers have appeared in a variety of scientific journals including the *Annals of Mathematical Statistics* and *Biometrics;* he is a former Associate Editor of *Biometrics.*

TEXT

Linear Models by S.R. Searle.

FEE

The fee for this course is $575. This includes text, lecture notes, and supplies. Make checks and purchase orders payable to GWU, Continuing Engineering Education.

REGISTRATION

Tentative or final registration should be made as soon as practicable. Fill out and mail the attached registration form, or apply by letter, telephone, TELEX, or purchase order to Continuing Engineering Education Program, George Washington University, Washington, D.C. 20052, **(202) 676-6106**, the toll free number **(800) 424-9773**, or **TELEX 64374 (International)**.

To facilitate registration by telephone, please mention the alphabetical priority code printed immediately to the right of the registration form.

TIME AND PLACE

Check-in will be at 8:15 a.m. on the first day in the 6th floor lobby of the University's Gelman Library, 2130 H St., N.W. (corner of 22nd and H), Washington, D.C. Classes will meet from 8:30 a.m. to 4:15 p.m. Parking is provided.

HOUSING AND MEALS

Housing and meals are not provided. However, there is a wide variety of hotels, motels, and restaurants nearby. Since hotel accommodations may be difficult to obtain, reservations should be made as early as possible. If you have difficulty obtaining reservations, we will be happy to assist you.

CONTINUING EDUCATION UNITS (CEU)

Course participants will receive a Certificate of Completion indicating the number of Continuing Education Units (CEUs) awarded for the course. The CEU is a standard measurement for noncredit continuing education programs. One CEU is given for each 10 contact hours in the classroom.

TEAM DISCOUNTS

Organizations are encouraged to take advantage of fee reductions for multiple registrations for the same course. Discounts of 10% are allowed for three to four registrants, 15% for five to nine registrants, and 20% for ten or more registrants from the same organization.

SPECIAL COURSES

Most of our courses can be presented on an in-house contract basis. New courses can be developed based on the specific training needs of your organization. In either case, the cost per capita is substantially lower than advertised fees. We will be happy to provide you with additional information.

UNIVERSITY POLICY ON EQUAL OPPORTUNITY

George Washington University does not discriminate against any person on the basis of race, color, religion, sex, national origin, age, handicap, or veteran status. This policy covers all programs, services, policies, and procedures of the University, including admission to educational programs and employment. The University is subject to the District of Columbia Human Rights Law.

Inquiries concerning the application of this policy and federal laws and regulations concerning discrimination in education or employment programs and activities may be addressed to Dr. Marianne Phelps, Assistant Provost for Affirmative Action, George Washington University, Rice Hall, Washington, D.C. 20052, or to the Assistant Secretary for Civil Rights of the Department of Education.

School of Engineering and Applied Science

Continuing Engineering Education

George Washington University

WASHINGTON, D.C. 20052
(202) 676-6106 or (800) 424-9733
TELEX 64374 (International)

Announces Four Short Courses To Be Held in Washington, D.C.

STATISTICAL METHODS IN DISCRETE EVENT SIMULATION
November 4-6, 1981
Course No. 496DC

BAYESIAN STATISTICS FOR ENGINEERS AND SCIENTISTS
November 9-13, 1981
Course No. 744DC

STATISTICAL METHODS IN RELIABILITY
December 14-18, 1981
Course No. 5DC

ANALYSIS OF VARIANCE FOR DATA HAVING UNEQUAL NUMBERS OF OBSERVATIONS IN THE SUBCLASSES
December 14-16, 1981
Course No. 558DC

Please Detach and Return

No. 496DC — STATISTICAL METHODS IN DISCRETE EVENT SIMULATION, November 4-6, 1981
No. 744DC — BAYESIAN STATISTICS FOR ENGINEERS AND SCIENTISTS, November 9-13, 1981
No. 5DC — STATISTICAL METHODS IN RELIABILITY, December 14-18, 1981
No. 558DC — ANALYSIS OF VARIANCE FOR DATA HAVING UNEQUAL NUMBERS OF OBSERVATIONS IN THE SUBCLASSES, December 14-16, 1981

registration form

A
B
C

Name _____
First Middle Last

Title _____

Organization _____

Address _____

City _____ State _____ Zip _____

Office Phone _____ Home Phone _____

Register me for course no. ☐ 496DC ☐ 5DC ☐ 744DC ☐ 558DC

☐ Payment enclosed ☐ Pay at course ☐ Bill office

☐ I am not interested in this course. Please place me on your mailing list for announcements of related course offerings.

Unforeseen
qualified sp

MAIL T
Continui
Universit

Continuing Engineering Education
George Washington University
Washington, D.C. 20052

Non-Profit Organization
U.S. POSTAGE
PAID
The George Washington University

078700000011 S9 0681
T NELSON
BOX 3
SCHOOLEY MT NJ 07870

Please Note: We occasionally mail to selected lists which cannot be cross-checked against our files. Therefore, you may receive a duplicate of this announcement. If so, we hope you will pass it along to an interested associate.